(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 713 641 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
29.05.1996 Bulletin 1996/22

(51) Int Cl.[6]: **A01J 5/017**, A01J 5/013, A01J 5/007

(21) Application number: **95203114.4**

(22) Date of filing: **15.11.1995**

(84) Designated Contracting States:
DE FR GB NL SE

(30) Priority: **22.11.1994 NL 9401942**

(71) Applicant: **MAASLAND N.V.**
NL-3155 PD Maasland (NL)

(72) Inventor: **Van den Berg, Karel**
NL-2971 BR Bleskensgraaf (NL)

(74) Representative: **Mulder, Herman et al**
Octrooibureau Van der Lely N.V.
Weverskade 10
3155 PD Maasland (NL)

(54) A method of automatically milking animals and an implement for applying same

(57) In a method of automatically milking animals, using a milking robot for automatically connecting teat cups (2) to the teats of an animal, respectively disconnecting same therefrom, and a milking implement by means of which the milk obtained via the teat cups (2) is discharged to a milk tank (6), there are used sensors (23 - 26) for monitoring the milking process and/or the quality of the milk and/or the health condition of the animals. For the signals supplied by one or more of these sensors (23 - 26) or for further signals deduced from a combination thereof, there is defined an average value over a fixed number of animals and/or over a fixed period of time. When, upon milking an animal, there is obtained a signal having a value that markedly differs from the corresponding average value, the sensor/sensors (23 - 26) supplying such a signal is/are regarded as being defective.

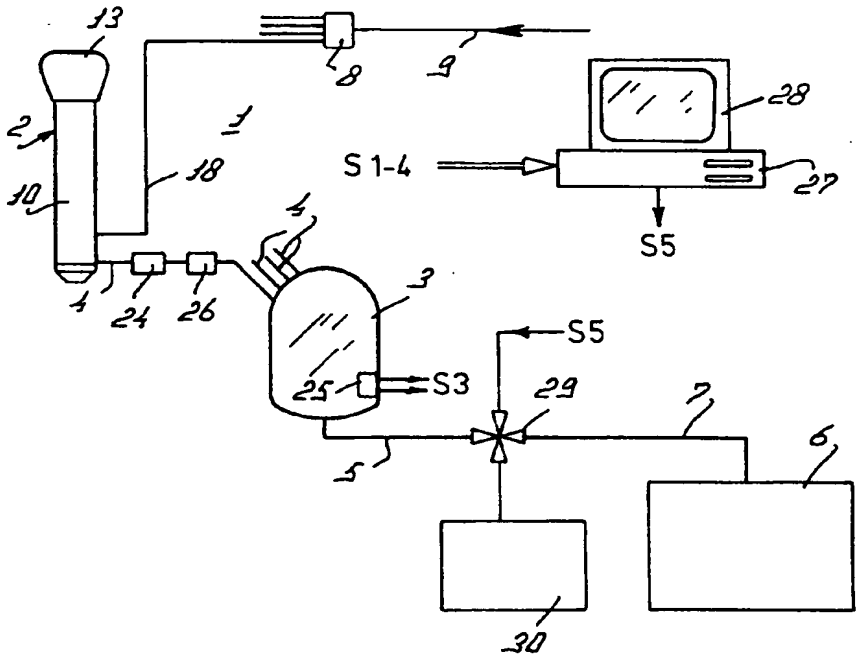

FIG. 1

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Description

The present invention relates to a method of automatically milking animals, such as cows, using a milking robot for automatically connecting teat cups to the teats of an animal, respectively disconnecting same therefrom, and a milking implement by means of which the milk obtained via the teat cups is discharged to a milk tank, which method furthermore implies the use of sensors for monitoring the milking process and/or the quality of the milk and/or the health condition of the animals.

A similar method is known from Dutch patent application no. 9101636. A problem arises when one or more of these sensors becomes/become defective. Therefore, the method according to the invention is characterized in that for the signals supplied by one or more of these sensors or for further signals deduced from a combination thereof, there is defined an average value over a fixed number of animals and/or over a fixed period of time, and in that, when, upon milking an animal, one of the said signals obtained has a value that deviates to some extent from the corresponding average value, the sensor/sensors supplying such a signal is/are regarded as being defective. This defectiveness of one or more sensors can be indicated via an attention list to be provided by the computer system used upon application of the method or via an other kind of alarm, such as check lights to be provided on the installation. In particular, defectiveness of some specific sensors should not result in the system getting out of order. Therefore, the method is furthermore characterized in that when, upon milking an animal, one of the said signals obtained has a value that deviates to some extent from the corresponding average value, the automatic milking of the animals continues to be effected.

Insofar as the sensors operate individually, the signals suplied thereby are capable of indicating the underpressure in one or more teat cups or in lines connected thereto, and/or the milk temperature, and/or the conductivity of the milk, and/or the start and the end of the milk flow. Besides, the further signals deduced from a combination of signals supplied by the sensors are capable of indicating the dead time, i.e. the time elapsed between the moment of connection of a teat cup and the moment of start of the milk flow, and/or the milking time, and/or the milking rate, and/or the milk yield. Therefore, as sensors there can be used vacuum sensors for detecting an underpressure in the teat cups and in the milk lines connected thereto, temperature sensors for recording the milk temperature, conductivity sensors for diagnosing mastitis or other infective diseases, and flow sensors for ascertaining the start and the end of a milk flow.

The present invention does not only relate to a method, but also to an implement for applying same, which implement is provided with a milking robot for automatically connecting teat cups to the teats of an animal, respectively disconnecting same therefrom, with a milking installation by means of which the milk obtained via the teat cups is discharged to a milk tank, and with sensors for monitoring the milking process and/or the milk quality and/or the health condition of the animals, as well as with a computer for controlling the implement. The implement is characterized in that the computer is designed to ascertain, after the supply of the signals originating from the sensors, whether or not a sensor has to be regarded as being defective and, if so, to indicate this defectiveness and to produce, if required, an alarm signal, while the automatic milking of the animals is to be continued.

For a better understanding of the invention and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings, in which:

Figure 1 shows schematically an arrangement of a milking implement according to the invention, and
Figure 2 shows in detail a teat cup.

Figure 1 shows a milking installation 1 for an implement for automatically milking animals, in which, for the sake of simplicity, only one teat cup 2 is represented. With the aid of a (non-shown) milking robot, the teat cups 2 can automatically be connected to the teats of an animal, respectively be disconnected therefrom. The milk obtained per udder quarter by means of the teat cups 2 can be supplied through separate milk lines 4 to a milk quantity measuring meter or milk glass 3. The discharge line 5 from the milk glass 3 is connected to a line 7 extending to the milk tank 6. Furthermore, the milking installation includes, insofar as relevant to the present invention, a pulsator system 8 for the four teat cups 2. The vacuum line 9 for the pulsator system 8 is connected, in a customary manner, to a vacuum pump having a balance tank.

Figure 2 shows a longitudinal cross-section of a teat cup 2, which is constructed, in a customary manner, from a rigid, e.g. metal, sleeve 10 having thereinside an inner wall 11 made of a flexible material, e.g. rubber, and a rubber cap 13 which closes off, at its upper end, the space 12 therebetween and the inner wall 11. At the lower end, the space between the sleeve 10 and the inner wall 11 is closed off by an end ring 14, while at some distance thereabove there is provided a ring 15 having an aperture 16. Between the end ring 14 and the ring 15 there is located a space, in which the pulsator system 8 produces over the line 18 and via an aperture 17 a pulsating vacuum, thereby effecting in the space between the sleeve 10 and the inner wall 11 a pulsating vacuum which causes the inner wall 11 to close firmly around the teat, when the teat cup is properly connected thereto, respectively causes the inner wall to move outwards again, in order that there is obtained the rhythmic movement around the teat as required in the milking operation. In order to function as a buffer for the milk to be collected and to minimize the fluctuations in the vacuum

under the teat, there is provided in the lower part of the teat cup a buffer space 19, in which a relatively narrow air suction aperture 20 is made for the purpose of milk transport. The line 4 serving to discharge the milk to the milk meter 3 is connected to this buffer space 19. In addition, the buffer space 19 contains a fixed element 21, which element partly projects into the aperture between the teat inner space 22 and the buffer space 19 to ensure that the milk flows gradually into the buffer space 19 and a splitting of the milk is prevented. At the upper end of the fixed element 21, there is provided a temperature-sensitive sensor 23 to perform a temperature measurement. The milk temperature, which can already be ascertained in this manner in the teat cup 2, is a good measure for the body temperature, which in case of sick cows, such as those which are affected by mastitis, is higher than normally. In a downwardly sloping part of the milk line 4 there is provided a flow sensor 24 to ascertain when the flow of milk starts and when it ends. This flow sensor operates here by establishing an electric connection between two electrodes by means of a flow of milk. The oblique position of the sensor prevents milk from remaining behind, i.e. it prevents a small quantity of milk from remaining between the electrodes, which would result in a permanent detection of a milk flow. The milk line 4 also includes a vacuum sensor 26 for ascertaining a sufficient vacuum in the milk line 4 and the teat cup 2. In the milk glass 3 there is provided a sensor 25 for ascertaining the electric conductivity in order to diagnose mastitis or an other infective disease. This sensor 25 includes a reservoir having electrodes for measuring the electric conductivity of the milk contained therein. Upon each new flow of milk, the milk present in the reservoir is replaced. In case the milk has been affected, an increased electric conductivity will be ascertained. A slight increase of the electric conductivity being detected at the start of each new flow of milk, it is also possible to ascertain by means of this mastitis sensor the start of a milk flow, instead of using a flow sensor or both sensors at the same time for the purpose. The control signals S1, S2, S3 and S4 from the respective sensors 23, 24, 25 and 26 are supplied to a computer 27, which processes the information received and renders it visible on the display screen 28. Furthermore, there is incorporated between the line 5 and the line 7 a three-way valve 29 for the purpose of discharging the milk flow from a mastitis-affected udder quarter to a waste tank 30. When, on the basis of the information received, the farmer decides to discharge milk to the waste tank 30 and gives an appropriate command to the computer, the three-way valve 29 is switched by means of a signal S5 supplied by the computer.

The signals supplied by the sensors 23, 24, 25 and 26 upon milking the subsequent animals can be averaged over a defined period of time, e.g. 24 hours, and/or over a number of animals, preferably all that are milked in the present implement. The animals being milked several times a day, this average value can be calculated each time as a progressive average. When, upon milking a specific animal, one of the said sensors indicates a value that markedly differs from the relevant average value, this will be an indication that the relevant sensor does not function properly. In the same way, average values can be defined of further signals to be deduced from combinations of signals supplied by several sensors. For example, the average value can be defined of the dead time, i.e. the time elapsed between the moment of connection of a teat cup, as established by a vacuum sensor 26, and the moment of start of the milk flow, as established by the flow sensor 24. An average value can also be defined of the milking time, i.e. the time elapsed between the start of the milk flow and the end thereof, which phenomena can both be detected with the aid of the flow sensor 24. It is also possible, in particular by means of the flow sensor 24 in combination with the defined quantity of milk collected in the milk glass 3 per milking turn, to deduce signals that are a measure for the milking rate and/or the milk yield. The values of these signals can be averaged as well. The said averaging processes are executed in the computer 27 and will all relate to a specific number of animals and/or a specific period of time. Signals supplied by one or more sensors upon milking separate animals and having a value that deviates from the relevant average value, will always be an indication that one or more sensors does/do not function properly. Such a defectiveness can be indicated by the computer 27 on an attention list, i.e. it can both be rendered visible on the display screen 28 and be printed. In addition, an alarm can be switched on, e.g. in the form of check lights to be provided on the implement. Generally speaking, the sensors being provided for the purpose of monitoring the milking process and/or the milk quality and/or the health condition of the animals, defectiveness of one or more sensors should not result in the whole process of automatic milking being interrupted. The computer programme will have to take into account that, although defectiveness of one or more sensors is ascertained, the automatic milking of the animals will have to be continued, anyway during the night. In the daytime, there may be designated periods of time, during which the automatic milking process is stopped and the defectiveness is repaired.

Claims

1. An implement, such as an implement for automatically milking animals, such as cows, provided with at least one milking robot, with one or more sensors and with one or more computers, characterized in that, if a signal, transmitted by one or more sensors, varies to a certain extent to a defined average value, the computer indicates that said sensor/sensors has to be regarded as being defective.

2. An implement, such as an implement as claimed in claim 1, characterized in that the computer is designed in such a way that it will define an average value during a fixed period of time and/or a fixed number of animals.

3. An implement, such as an implement as claimed in claim 1 or 2, characterized in that the signals can be transmitted by one or more sensors or a combination thereof.

4. An implement for applying the method as claimed in any one of the preceding claims, which implement is provided with a milking robot for automatically connecting teat cups (2) to the teats of an animal, respectively disconnecting same therefrom, with a milking installation by means of which the milk obtained via the teat cups (2) is discharged to a milk tank (6), and with sensors (23 - 26) for monitoring the milking process and/or the milk quality and/or the health condition of the animals, as well as with a computer (27) for controlling the implement, characterized in that the computer (27) is designed to ascertain, after the supply of the signals (S1 - 4) originating from the sensors (23 - 26), whether or not a sensor has to be regarded as being defective and, if so, to indicate this defectiveness and to produce, if desired, an alarm signal, while the automatic milking of the animals is to be continued.

5. A method, such as a method of automatically milking animals, such as cows, using at least one milking robot and using one or more sensors, characterized in that the sensor/sensors are regarded as being defective, if a signal, transmitted by the sensor/sensors, or a combination thereof, varies to a certain extent to a defined average.

6. A method, such as a method as claimed in claim 5, characterized in that the average value of the signals of the sensor/sensors, or a combination thereof, is defined during a fixed period of time and/or a fixed number of animals.

7. A method of automatically milking animals, such as cows, using a milking robot for automatically connecting teat cups to the teats of an animal, respectively disconnecting same therefrom, and a milking implement by means of which the milk obtained via the teat cups is discharged to a milk tank, which method furthermore implies the use of sensors for monitoring the milking process and/or the quality of the milk and/or the health condition of the animals, characterized in that for the signals supplied by one or more of these sensors or for further signals deduced from a combination thereof, there is defined an average value over a fixed number of animals and/or over a fixed period of time, and in that, when, upon milking an animal, one of the said signals obtained has a value that deviates to some extent from the corresponding average value, the sensor/sensors supplying such a signal is/are regarded as being defective.

8. A method as claimed in claim 7, characterized in that, when one of said signals has a value that deviates to some extent from the corresponding average value, this is indicated by an attention list or by an other kind of alarm, such as check lights.

9. A method as claimed in claim 7 or 8, characterized in that, when one of said signals has a value that deviates to some extent from the corresponding average value, the automatic milking of the animals continues.

10. A method as claimed in any one of the preceding claims, characterized in that the signals transmitted by the sensors are capable of indicating an underpressure in one or more teat cups or in lines connected thereto, and/or the milk temperature, and/or the conductivity of the milk, and/or the start and the end of the milk flow.

11. A method as claimed in any one of the preceding claims, characterized in that the further signals deduced from a combination of signals transmitted by the sensors are capable of indicating the dead time, i.e. the time elapsed between the moment of connection of a teat cup and the moment of start of the milk flow, and/or the milking time, and/or the milking rate, and/or the milk yield.

12. A method as claimed in any one of the preceding claims, characterized in that as sensors there are used vacuum sensors for detecting an underpressure in the teat cups and in the milk lines connected thereto, temperature sensors for recording the milk temperature, conductivity sensors for diagnosing mastitis or other infective diseases, and flow sensors for ascertaining the start and the end of a milk flow.

13. A method as claimed in any one of the preceding claims, characterized in that from the signals obtained or the deduced further signals there is defined a 24-hours average.

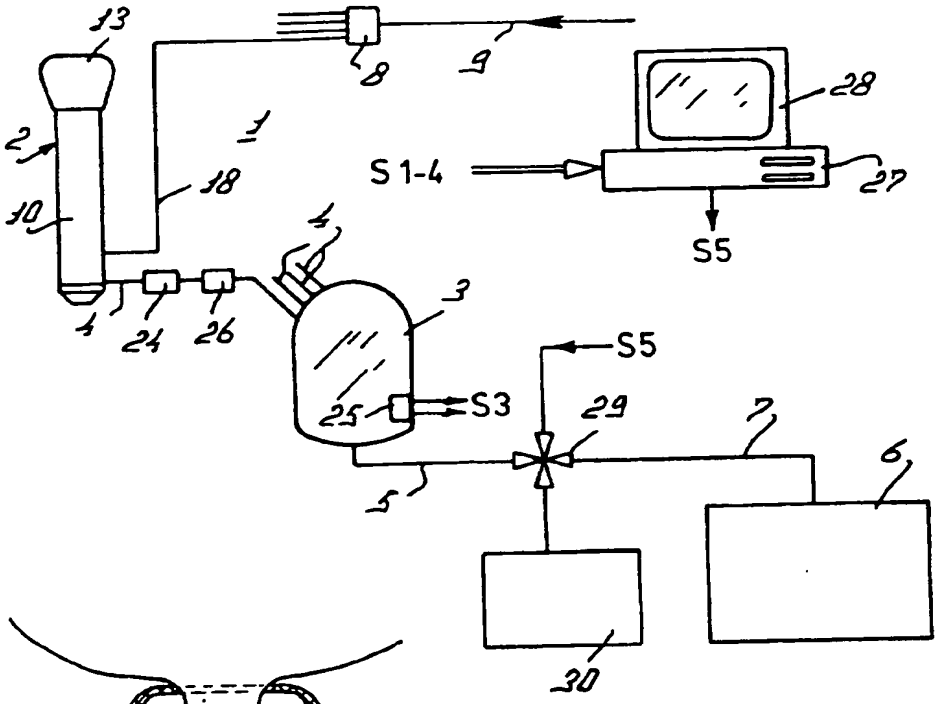
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FIG. 1

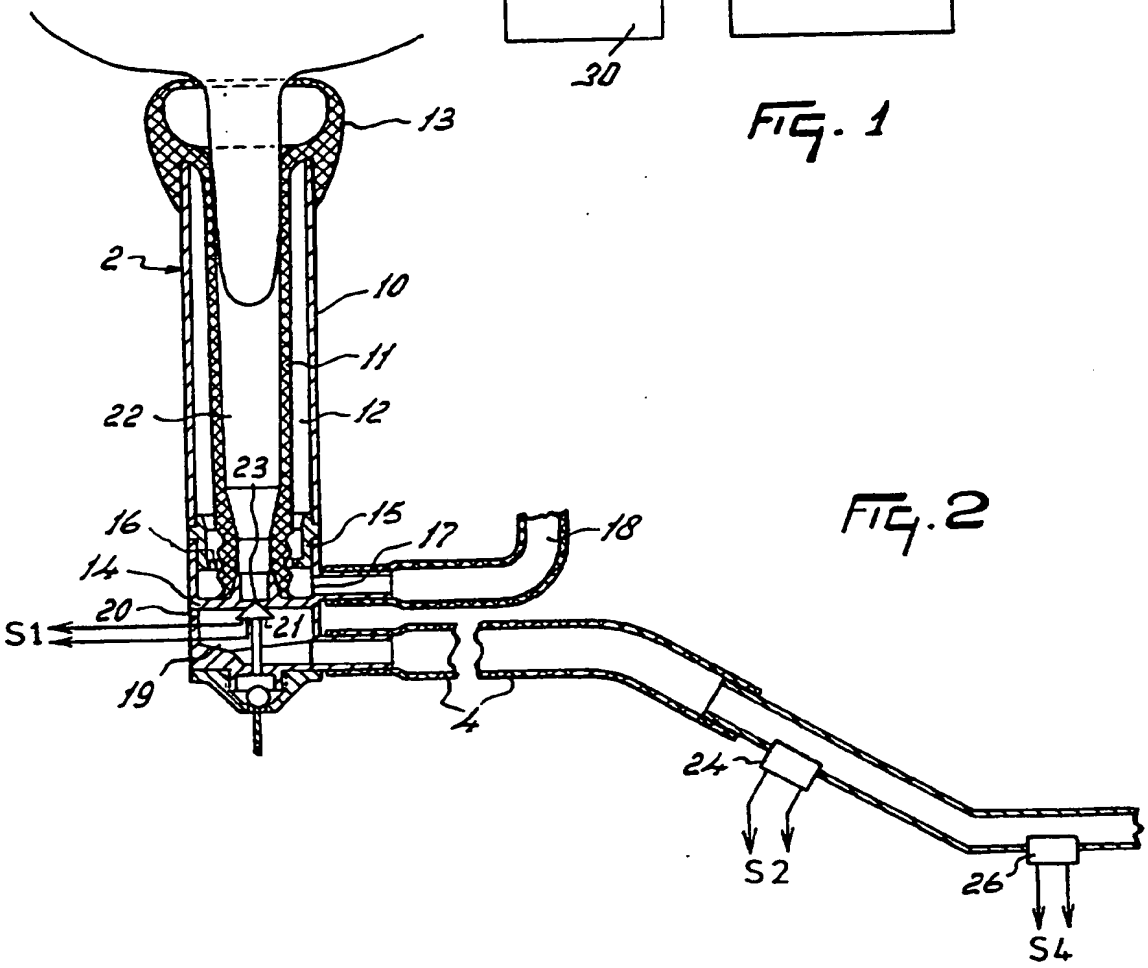
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FIG. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 95 20 3114

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A D	EP-A-0 534 564 (VAN DER LELY) 31 March 1993 * claims; figures * & NL-A-9 101 636 (VAN DER LELY)	1,7	A01J5/017 A01J5/013 A01J5/007
A	EP-A-0 576 086 (VAN DER LELY) 29 December 1993 * claims 1,2; figures *	1,7	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

A01J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	25 January 1996	Piriou, J-C

CATEGORY OF CITED DOCUMENTS

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